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Oh et al.

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(54) **CYCLONE DUST-SEPARATING APPARATUS OF VACUUM CLEANER**

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(51) **Int. Cl.**
B01D 50/00 (2006.01)

(52) **U.S. Cl.** **55/337**; 55/361; 55/368; 55/378; 55/365; 55/366; 55/428; 55/429; 55/424; 55/430; 55/431; 55/DIG. 2; 55/DIG. 3; 55/DIG. 26; 15/353; 15/352

(58) **Field of Classification Search** ..... 55/337, 55/361, 368, 378, 365, 366, 428, 429, 424, 55/430, 431, DIG. 2, DIG. 3, DIG. 26; 15/352, 15/353

See application file for complete search history.

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(74) *Attorney, Agent, or Firm*—Ohlandt, Greeley, Ruggiero & Perle, L.L.P.

(57) **ABSTRACT**

A cyclone dust-separating apparatus includes a cyclone unit having air inflow and air outflow parts that separate dust or dirt from air, the cyclone unit being installed such that a longitudinal axis thereof is substantially horizontally arranged; a dust bin joined to a bottom end of the cyclone unit that collects the dust or dirt separated by the cyclone unit, the dust bin installed in such a manner that a longitudinal axis thereof is substantially perpendicular to the longitudinal axis of the cyclone unit; a nonporous envelope detachably disposed in the dust bin that stores the dust or dirt collected into the dust bin; and a pressure difference-generating passage to communicate an outlet of the air outflow part and the dust bin with each other so as to allow the nonporous envelope to come in contact with an inner surface of the dust bin by a pressure difference between the dust bin and the air outflow part.

17 Claims, 11 Drawing Sheets

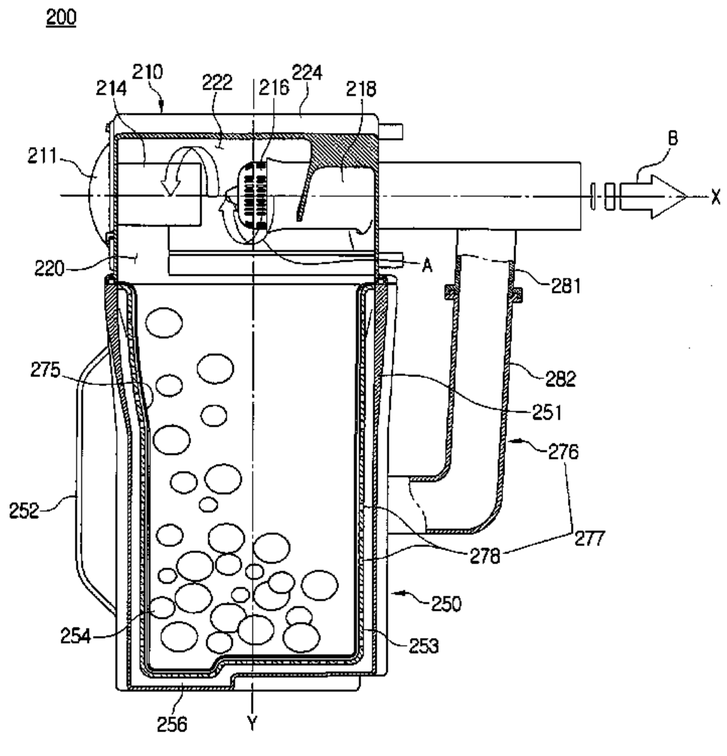

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FIG. 1

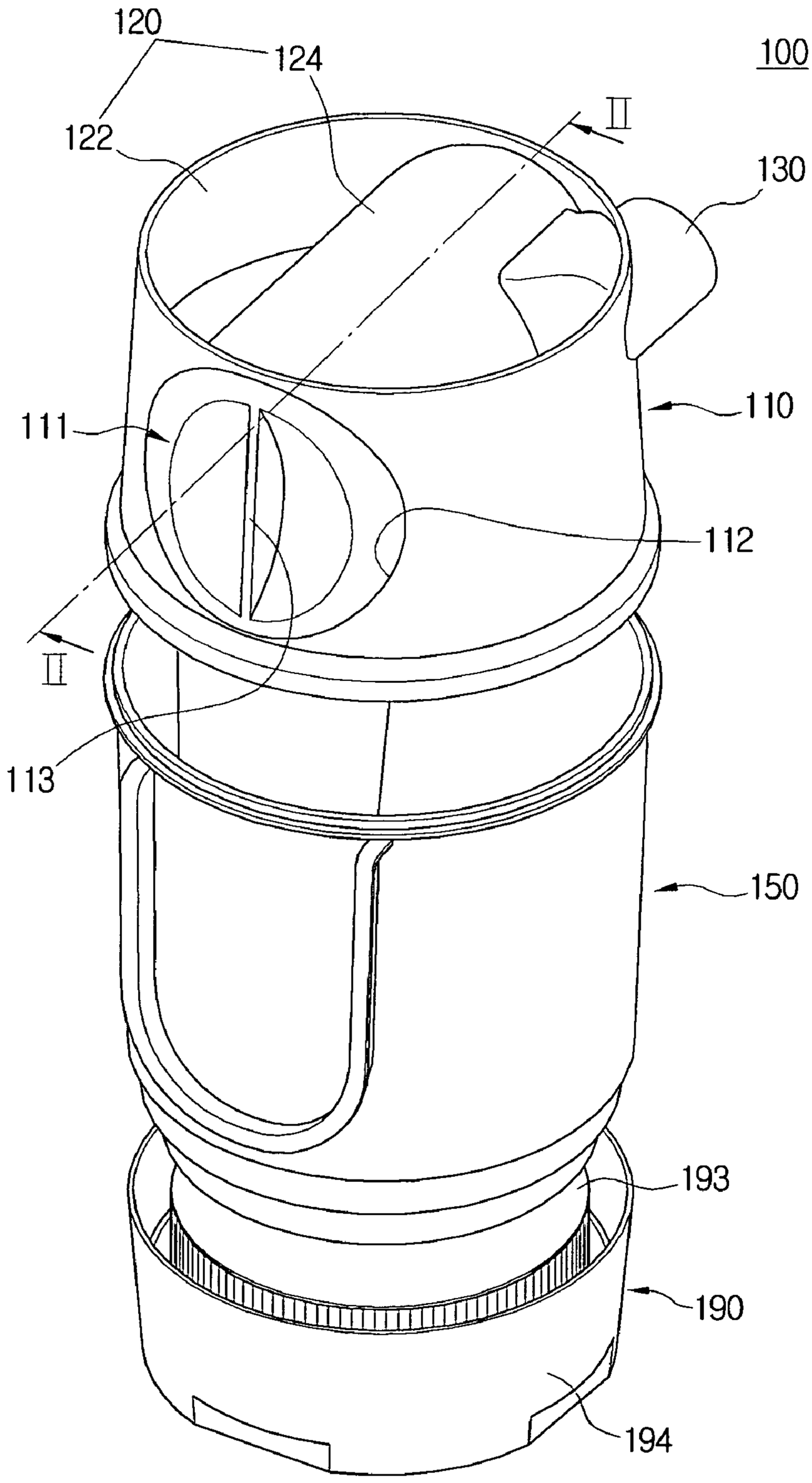
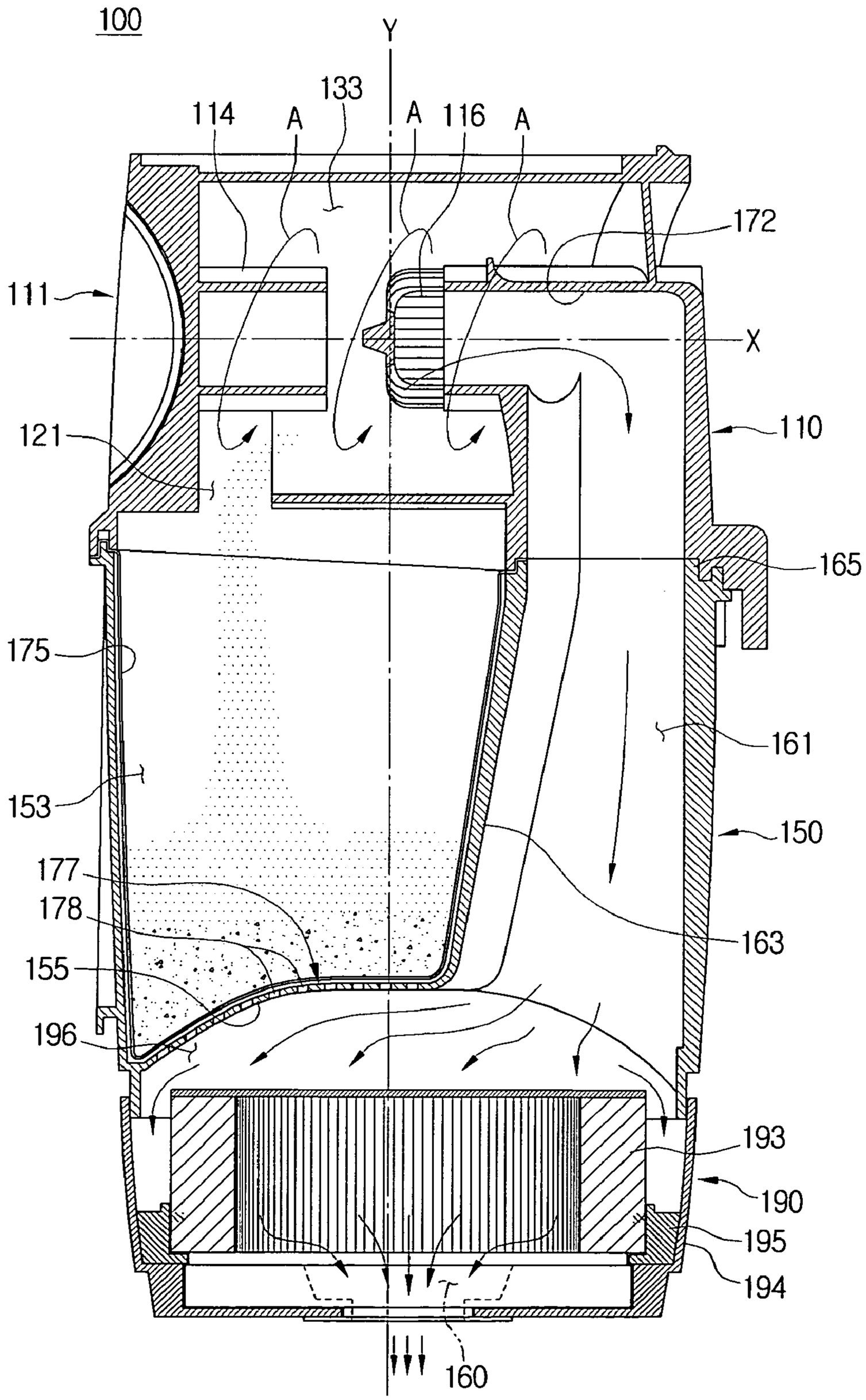


FIG. 2


100
Y
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114
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111
X
121
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194
160

FIG. 3

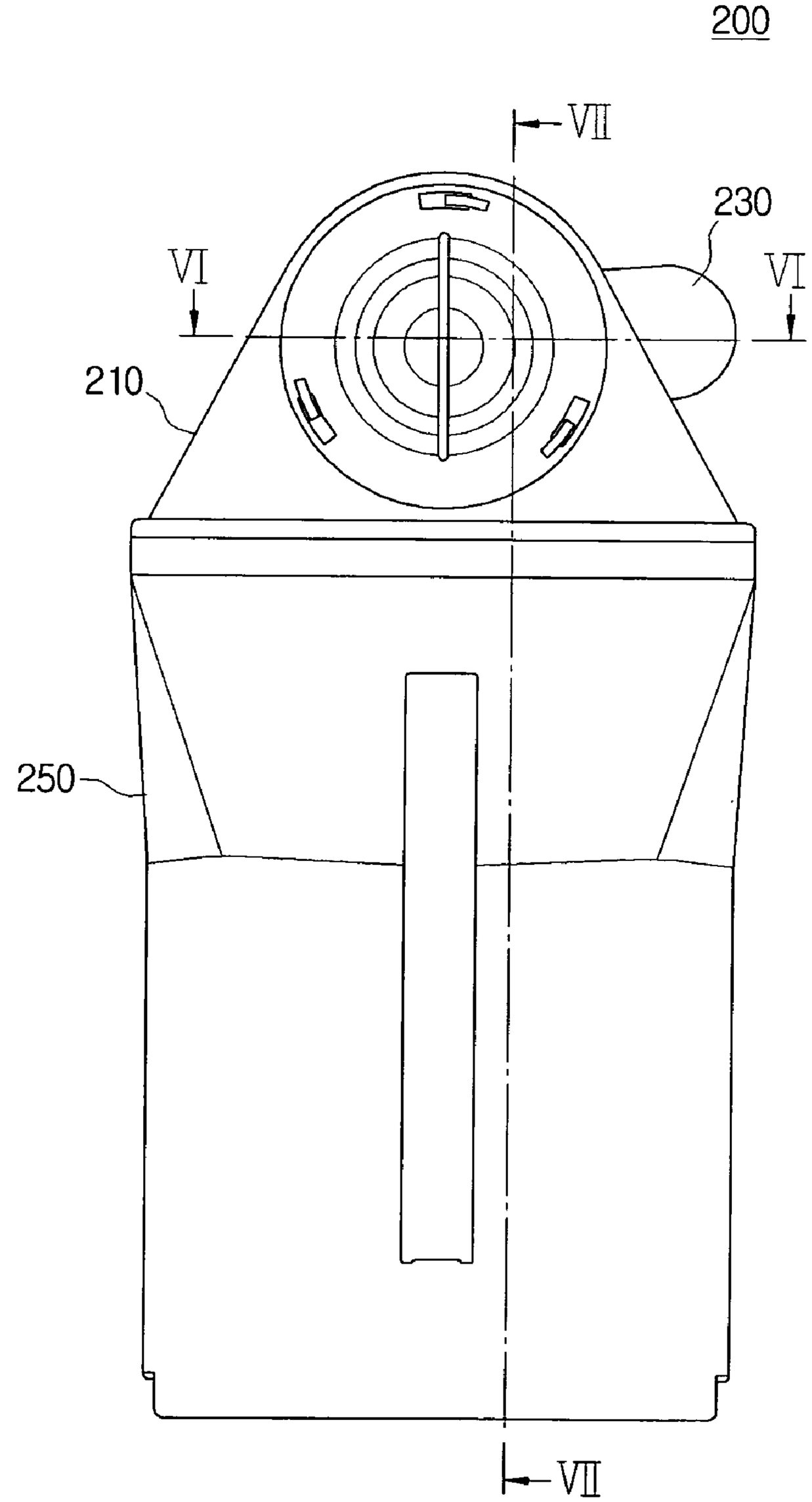

FIG. 4

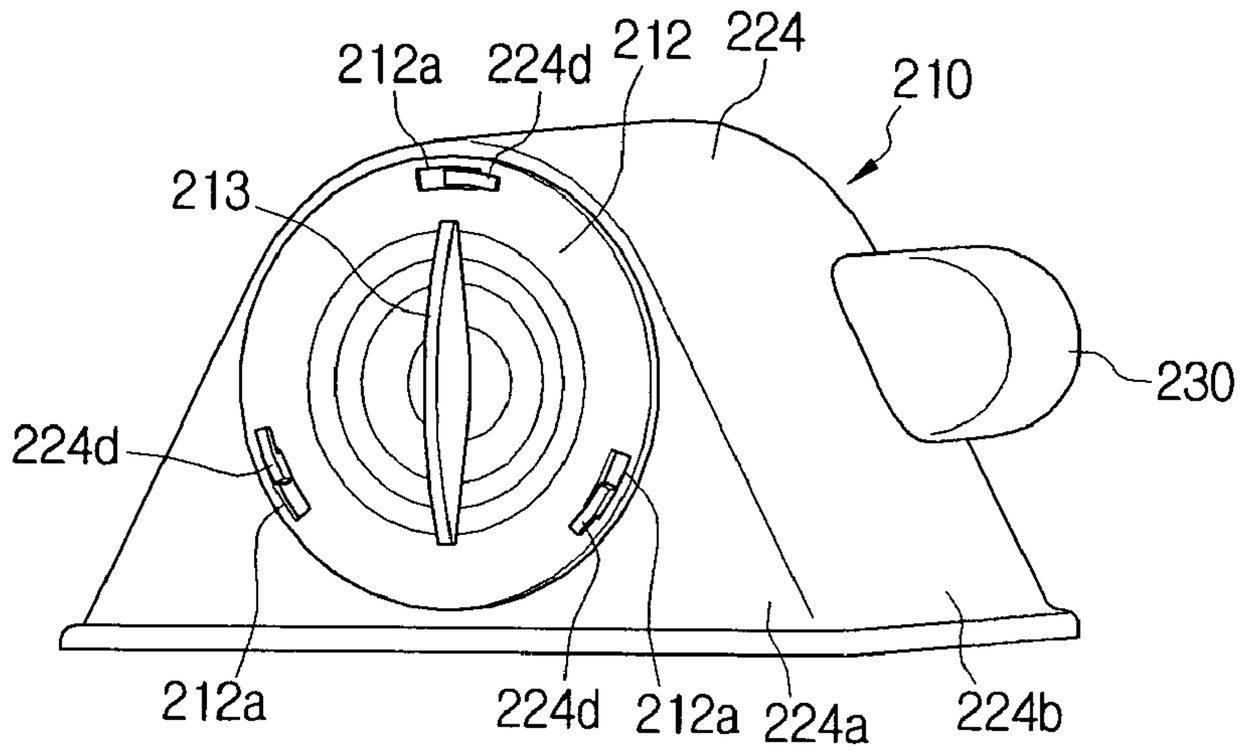
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FIG. 5

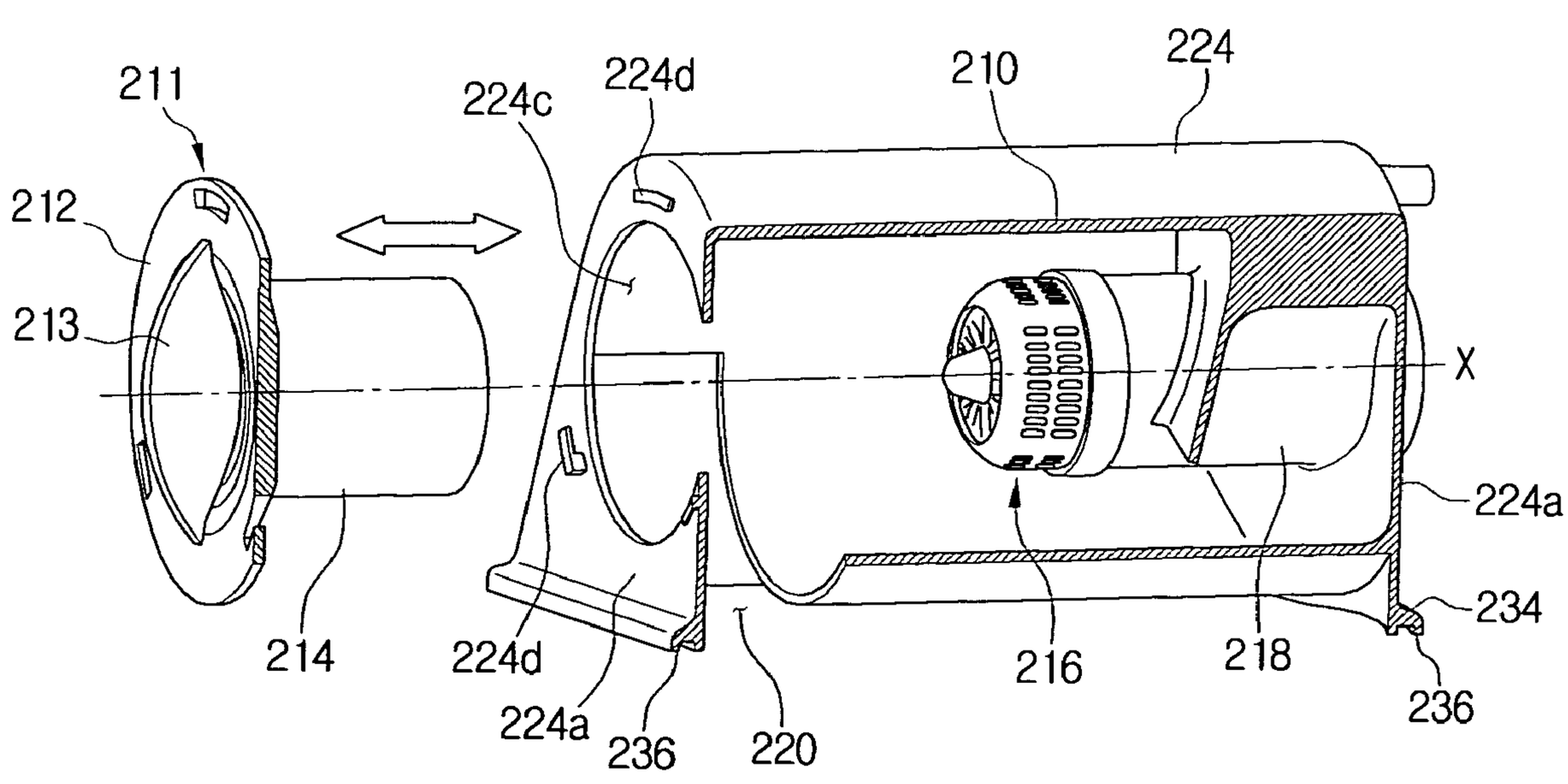
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FIG. 6

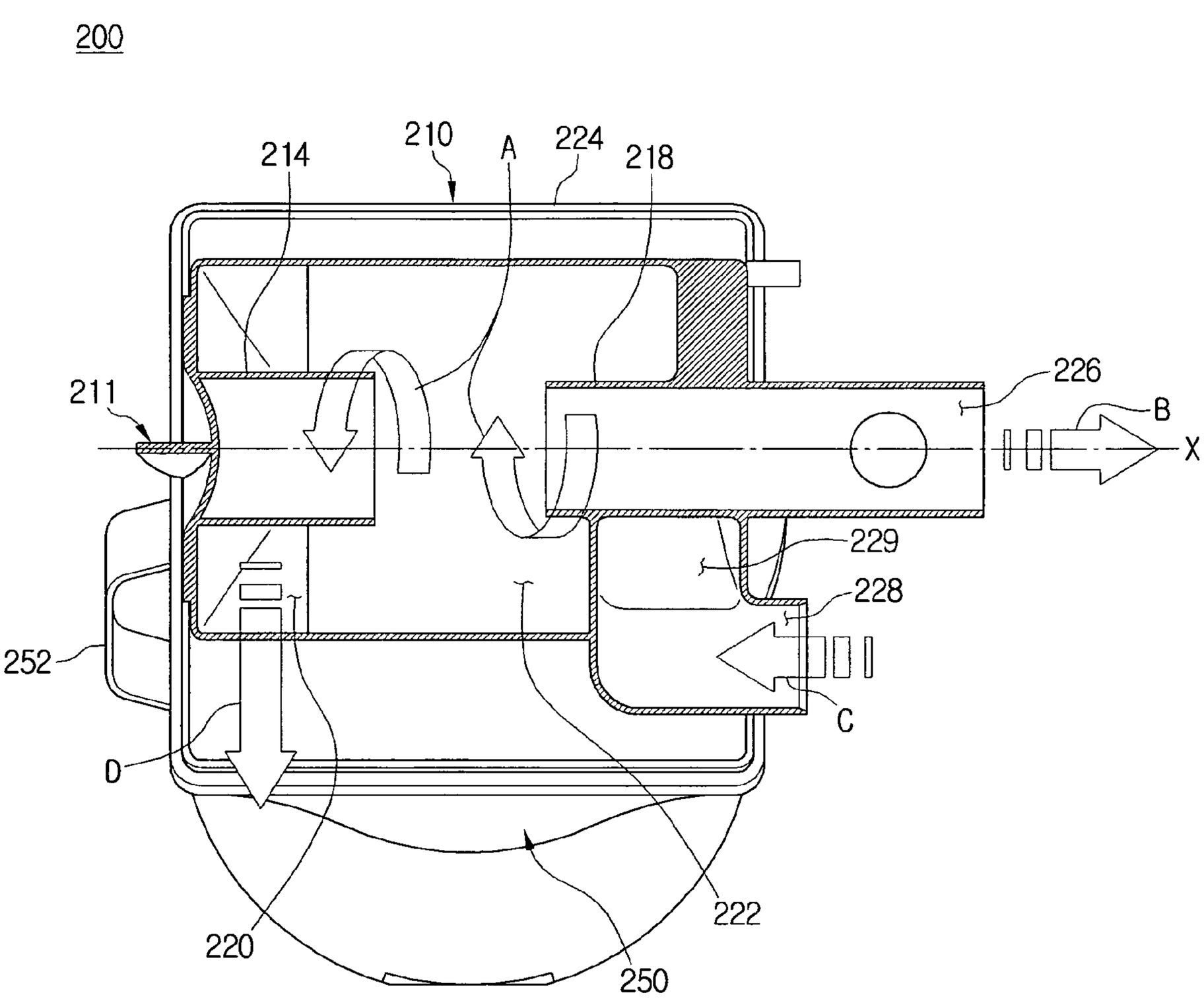
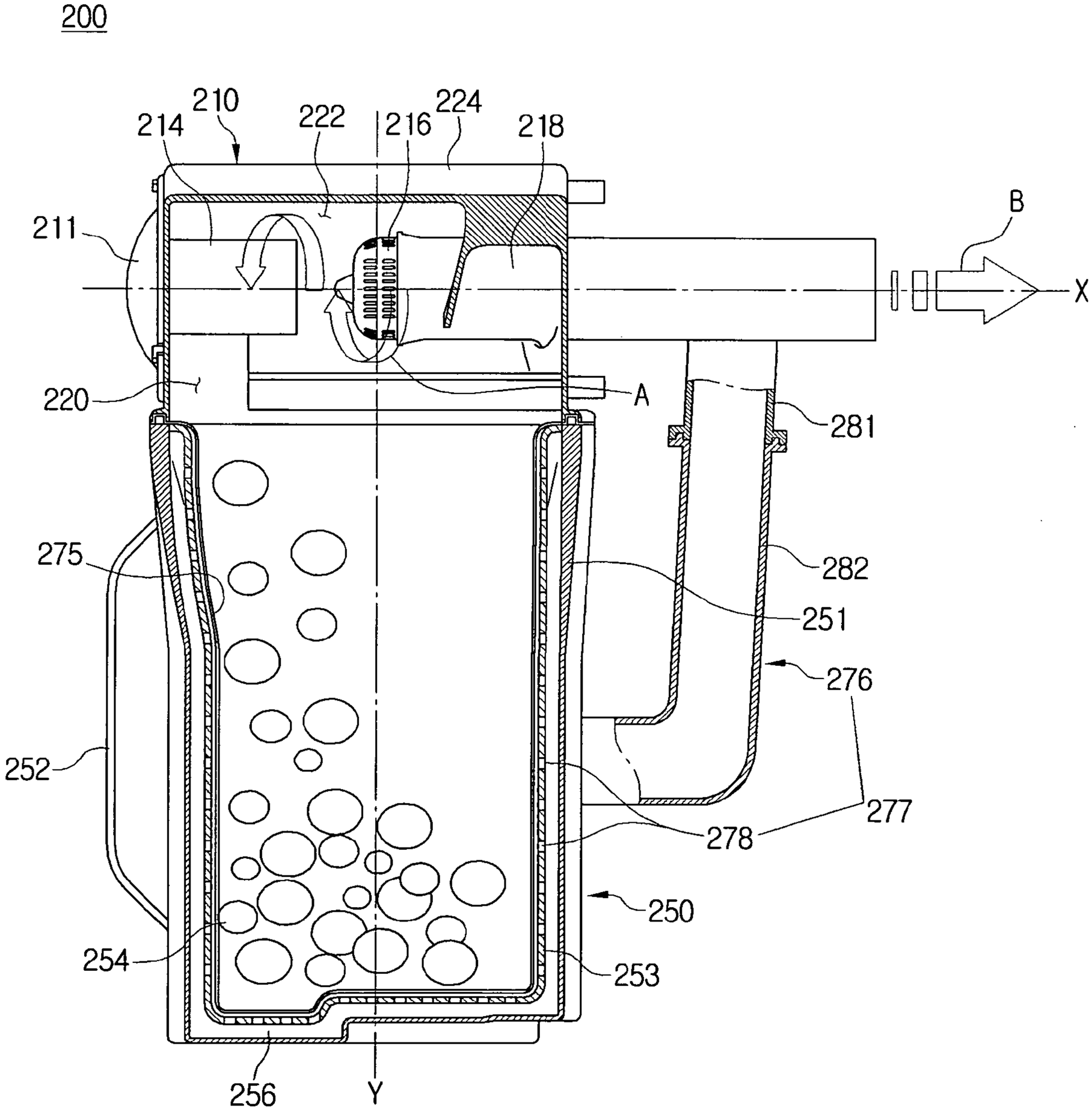


FIG. 7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256
Y

FIG. 8

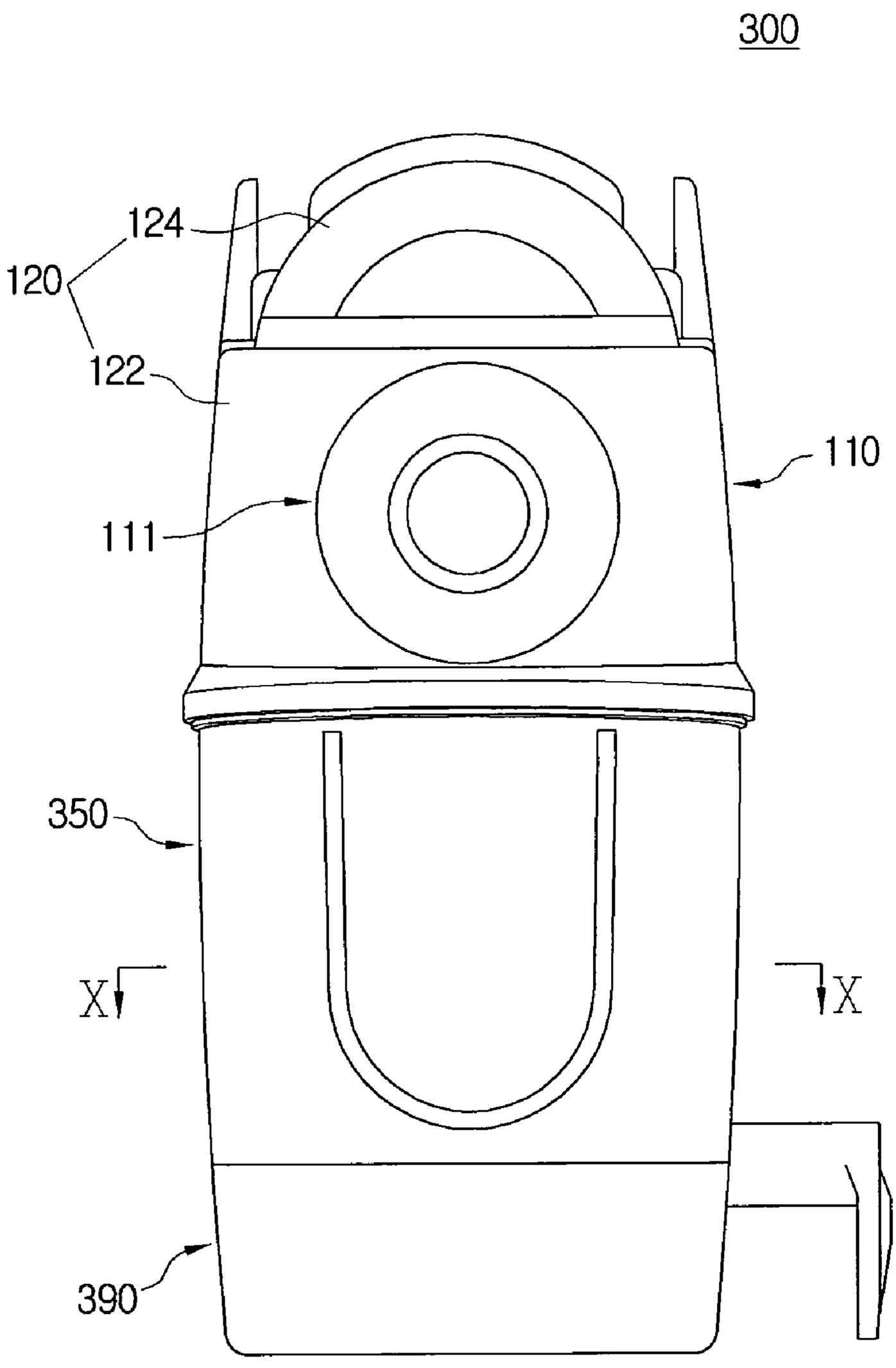

FIG. 9

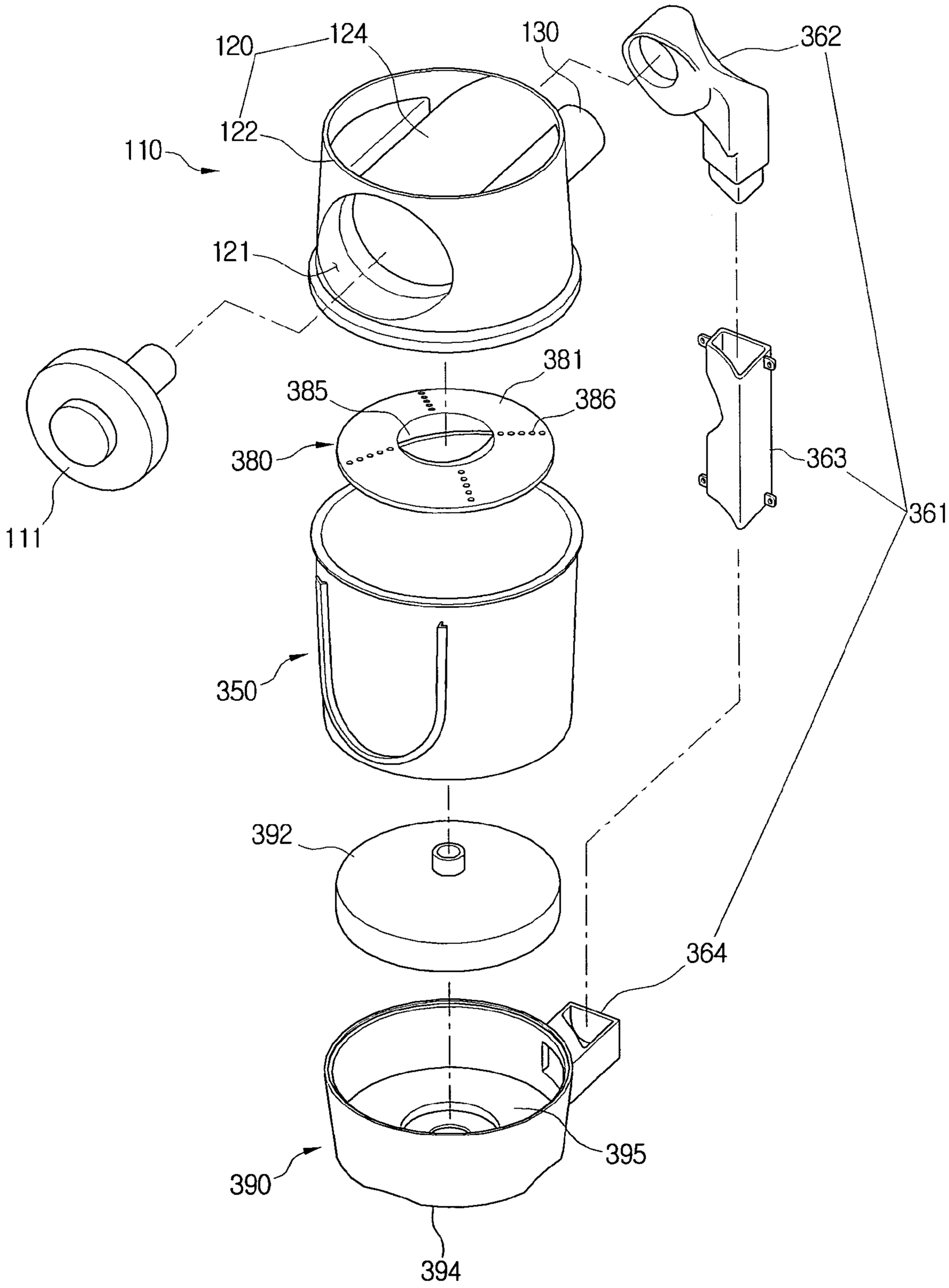
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FIG. 10A

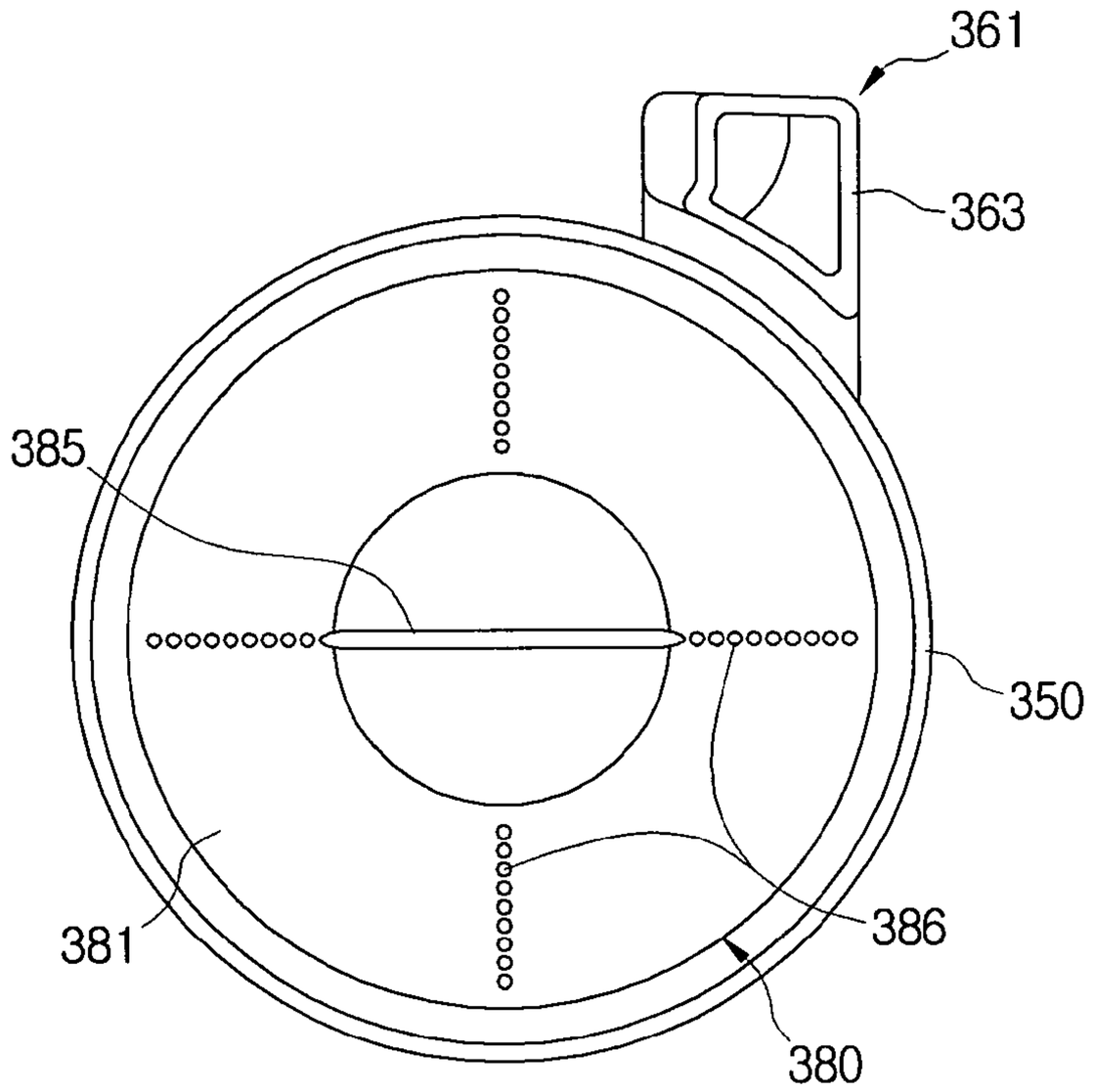

FIG. 10B

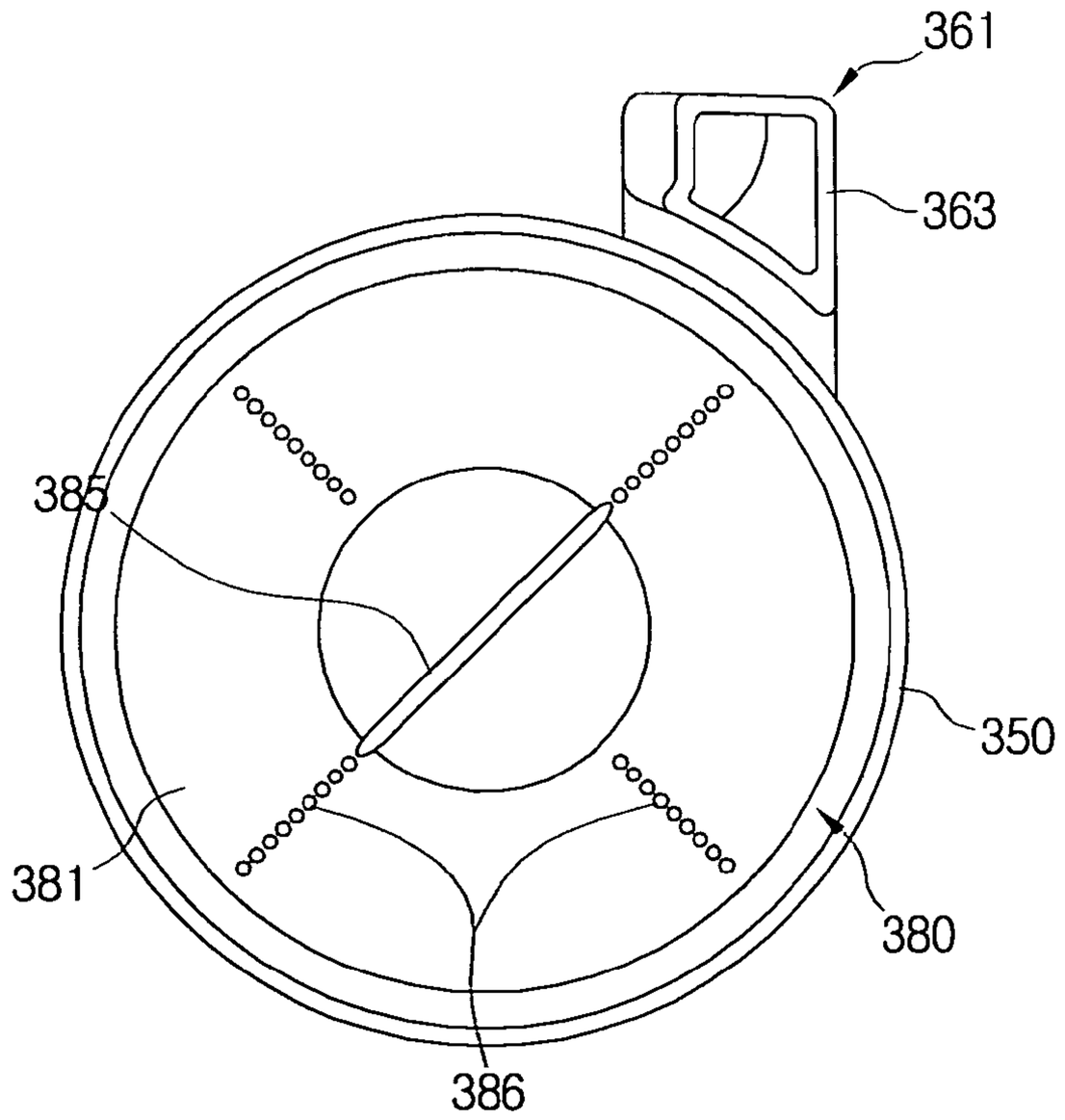

FIG. 11A

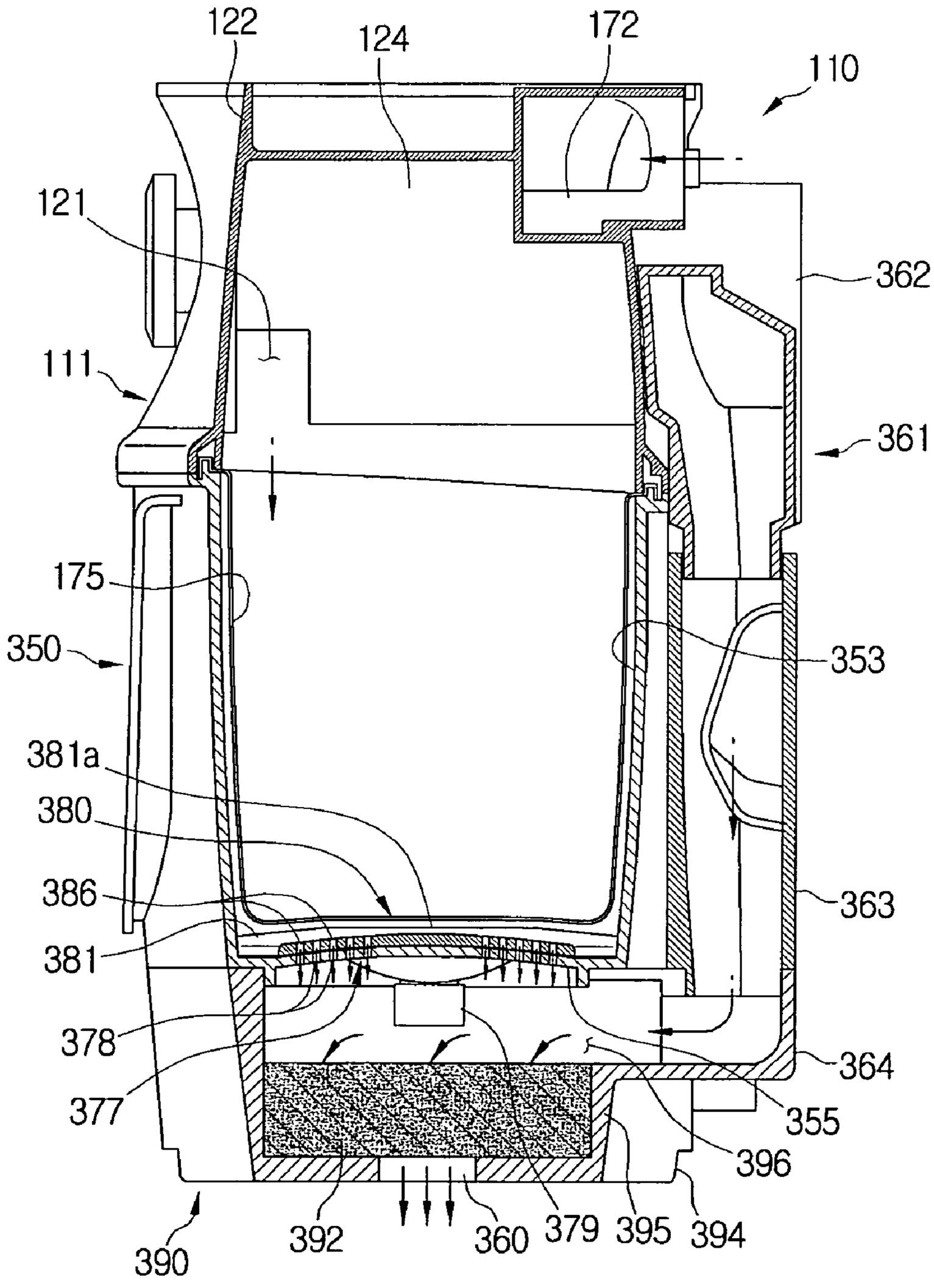
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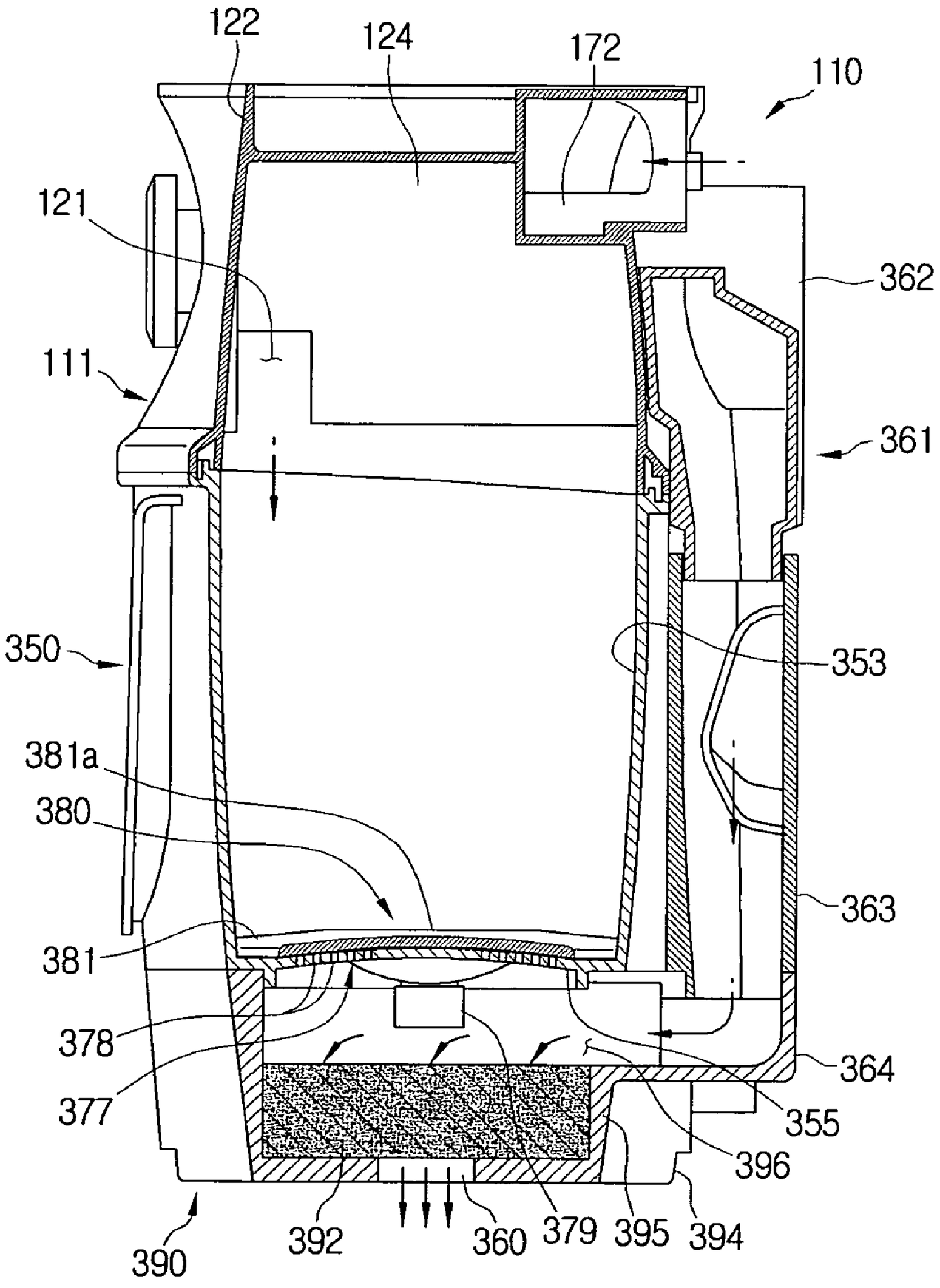
FIG. 11B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CYCLONE DUST-SEPARATING APPARATUS OF VACUUM CLEANER

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit under 35 U.S.C. §119 (a) of U.S. Provisional Patent Application No. 60/967,453, filed Sep. 5, 2007, in the United States Patent and Trademark Office, and Korean Patent Application Nos. 10-2007-0101101, filed on Oct. 8, 2007, in the Korean Intellectual Property Office, the entire contents of which are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present disclosure relates to a vacuum cleaner. More particularly, the present disclosure relates to a cyclone dust-separating apparatus of a vacuum cleaner, that draws in an external air and then separates dust or dirt therefrom.

2. Description of the Related Art

In general, a cyclone dust-separating apparatus provided in a vacuum cleaner is an apparatus that whirls air laden with dirt or dust and separates the dirt or dust therefrom. Such a cyclone dust-separating apparatus usually is provided with a cyclone unit vertically and elongately installed, a cyclone body with an air inflow part and an air outflow part formed at a side and a top thereof, and a dust bin connected to a bottom part of the cyclone unit, as disclosed in U.S. Pat. No. 6,350,292. Accordingly, external air is drawn in through the side of the cyclone body and lowered while being swirled therein, and dirt or dust removed from the air is collected in the dust bin. However, the conventional cyclone dust-separating apparatus as described above requires forming the dust bin in a relatively small size because the cyclone unit has a large height. As a result, the conventional cyclone dust-separating apparatus is inconvenient to use, in that the dirt or dust collected in the dust bin should be frequently dumped.

In addition, Korean Patent No. 412,583 discloses a cyclone dust-separating apparatus of an upright cleaner, in which a dust bin is coupled to a bottom end of a cylindrical cyclone unit, the diameter of the dust bin being equal to that of the cylindrical cyclone unit. External air drawn into the cyclone unit through a side of the cyclone unit is whirled while lowering within an internal space of the dust bin as well as within an internal space of the cyclone unit. Accordingly, such a conventional cyclone dust-separating apparatus is disadvantageous in that because the cyclone unit is vertically arranged, the capacity of the dust bin is relatively small. Furthermore, there is a problem in that because the air whirling within the cyclone unit is lowered to the internal space of the dust bin, the dust stored within the dust bin is entrained by the swirling air and flows backward to the cyclone unit.

Also, the cyclone dust-separating apparatuses of U.S. Pat. No. 6,350,292 and Korean Patent No. 412,583 are advantageous in that they can be semi-permanently used without any inconvenience of frequently replacing dust bags as in the conventional general dust-collecting apparatus, but disadvantageous in that since the dust or dirt is collected and stored in the dust bin, a scattering of the dust or dirt and/or a contamination of circumference according thereto are generated when the dust or dirt collected in the dust bin is dumped.

SUMMARY OF THE INVENTION

An aspect of the present disclosure is to address at least the above problems and/or disadvantages and to provide at least the advantages described below. Accordingly, an aspect of the present disclosure is to provide a cyclone dust-separating apparatus having a dust bin, the volume of which is increased as compared with other cyclone dust-separating apparatuses of the same height.

Another aspect of the present disclosure is to provide a cyclone dust-separating apparatus in which dirt or dust collected in the dust bin is prevented from flowing backward.

Further another aspect of the present disclosure is to provide a cyclone dust-separating apparatus that prevents the dirt or dust collected in the dust bin from scattering and/or contaminating a circumference due to the scattering of the dust or dirt when the dirt or dust collected in the dust bin is dumped.

In accordance with an aspect of the present disclosure, a cyclone dust-separating apparatus includes a cyclone unit having an air inflow part and an air outflow part so as to separate dust or dirt from air, the cyclone unit being installed in such a manner that a longitudinal axis thereof is substantially horizontally arranged; a dust bin joined to a bottom end of the cyclone unit so as to collect the dust or dirt separated by the cyclone unit, the dust bin being installed in such a manner that a longitudinal axis thereof is substantially perpendicular to the longitudinal axis of the cyclone unit; a nonporous envelope detachably disposed in the dust bin so as to store the dust or dirt collected into the dust bin; and a pressure difference-generating passage to communicate an outlet of the air outflow part and the dust bin with each other so as to allow the nonporous envelope to come in contact with an inner surface of the dust bin by a pressure difference between the dust bin and the air outflow part.

The dust bin may include an air discharging passage connected with the air outflow part, so that the air discharged from the cyclone unit penetrates through the dust bin and discharges in a direction toward a bottom end of the dust bin, and the pressure difference-generating passage may include a plurality of openings formed in the dust bin so as to allow the dust bin to communicate with the air discharging passage. Here, the air discharging passage may be disposed to penetrate through a dust bin chamber of the dust bin in upward and downward directions. Particularly, the air discharging passage may be formed on one side of the dust bin chamber, so that a width of air path thereof is gradually enlarged from an upper part to a lower part thereof.

Also, the cyclone dust-separating apparatus may further include a filter unit joined to the bottom end of the dust bin so as to filter dust or dirt included in the air discharged through the air discharging passage from the cyclone unit. Here, preferably, but not necessarily, the filter unit includes a filter cover joined to the bottom end of the dust bin to form a filter chamber in a predetermined volume, and a filter member disposed in the filter chamber. In this case, the filter member may include a pleated cylindrical filter, an upper part of which is blocked.

In accordance with another aspect of the present disclosure, the dust bin may include an outer tub, and an inner tub disposed in a spaced-apart relation to the outer tub so as to form an air flowing space between the outer tub and the inner tub, the inner tube at an upper part thereof being joined with the outer tub, and the pressure difference-generating passage may include a subsidiary passage disposed between the air outflow part of the cyclone unit and the outer tub so as to communicate between the air outflow part and the air flowing space, and a plurality of openings formed in the inner tub of the dust bin so as to allow the inner tub of the dust bin to communicate with the subsidiary passage through the air flowing space.

In accordance with further another aspect of the present disclosure, the cyclone dust-separating apparatus may further include an air discharging passage connected with the air outflow part, so that the air discharged from the cyclone unit is flowed in a direction toward a bottom end of the dust bin along an outside of the dust bin and then discharged, and the pressure difference-generating passage may include a plurality of openings formed in the dust bin so as to allow the dust bin to communicate with the air discharging passage.

A close up-switching part may be disposed to the pressure difference-generating passage so as to close up the plurality of openings when the nonporous envelope is not used. The close up-switching part may include a rotating plate rotatably disposed to the dust bin and having a plurality of homologous openings corresponding to the plurality of openings, and a knob formed on the rotating plate so as to rotate the rotating plate.

Also, the cyclone dust-separating apparatus may further include a filter unit joined to the bottom end of the dust bin so as to filter dust or dirt included in the air discharged through the air discharging passage from the cyclone unit. Here, preferably, but not necessarily, the filter unit includes a filter cover joined to the bottom end of the dust bin to form a filter chamber in a predetermined volume, and a filter member disposed in the filter chamber. In this case, the filter member may include a porous filter fixed on a filter mount of the filter cover.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features, and advantages of certain exemplary embodiments of the present disclosure will be more apparent from the following description taken in conjunction with the accompanying drawings, in which:

FIG. **1** is an exploded perspective view exemplifying a cyclone dust-separating apparatus of a vacuum cleaner;

FIG. **2** is a cross-sectional view of the cyclone dust-separating apparatus taken along line II-II of FIG. **1**;

FIG. **3** is a side elevation exemplifying a cyclone dust-separating apparatus of a vacuum cleaner;

FIG. **4** is a perspective view exemplifying only a cyclone unit of the cyclone dust-separating apparatus illustrated in FIG. **3**;

FIG. **5** is a partially cut-away and exploded perspective view of the cyclone unit of the cyclone dust-separating apparatus illustrated in FIG. **3**;

FIG. **6** is a cross-sectional view of the cyclone dust-separating apparatus taken along line VI-VI of FIG. **3**;

FIG. **7** is a cross-sectional view of the cyclone dust-separating apparatus taken along line VII-VII of FIG. **3**;

FIG. **8** is a side elevation exemplifying a cyclone dust-separating apparatus of a vacuum cleaner;

FIG. **9** is an exploded perspective view of the cyclone dust-separating apparatus illustrated in FIG. **8**;

FIGS. **10**A and **10**B are cross-sectional views of the cyclone dust-separating apparatus taken along line X-X of FIG. **8**; and

FIGS. **11**A and **11**B are cross-sectional views exemplifying an operation of a close up-switching part of the cyclone dust-separating apparatus illustrated in FIG. **8**.

Throughout the drawings, the same reference numerals will be understood to refer to the same elements, features, and structures.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

Hereinafter, certain exemplary embodiments of the present disclosure will be described in detail with reference to the accompanying drawing figures.

FIGS. **1** and **2** are a perspective view and a cross-sectional view schematically exemplifying a cyclone dust-separating apparatus of a vacuum cleaner.

Referring to FIGS. **1** and **2**, the cyclone dust-separating apparatus **100** includes a cyclone unit **110**, a dust bin **150**, a nonporous envelope **175**, a pressure difference-generating passage **177** and a filter unit **190**.

The cyclone unit **110** is provided with a cyclone body **120**, a guide unit **111** detachably disposed on a side surface of the cyclone body **120**, a filter **116**, an outflow pipe **172**, and an inflow pipe **130**.

The cyclone body **120** has an outer body **122** and an inner body **124**. The inner body **124** is formed in a laid cylinder shape arranged in such a manner that its longitudinal axis X extends substantially in the horizontal direction, as explained in the cyclone body **124**, and the outer body **122** is formed in a stand-up cylinder shape arranged in such a manner that its longitudinal axis Y extends substantially in the vertical direction.

The guide unit **111** is mounted in a mounting opening **112** formed on one side surface of the outer body **122** of the cyclone body **120**. The guide unit **111** has a knob **112** and a guide pipe **114**. A handle **113** is projected from a center of the knob **212** so as to be capable of being gripped by a user. The guide pipe **114** is connected to a side of the knob **112** and installed to project into the inside of the inner body **124** of the cyclone body **120**.

The filter **116** is removably mounted on an end of the outflow pipe **172**, and air drawn in into the inside of the cyclone body **120** is discharged to the outside via the outflow pipe **172** after separating dirt or dust therefrom through the filter **116**. In the present embodiment, the filter **116** is formed of a grill member with a plurality of through-holes. In the cyclone unit **110**, the guide pipe **114** and the outflow pipe **172** are substantially horizontally arranged.

As illustrated in FIG. **2**, the outflow pipe **172** is formed in an inverted L-shape. On one end of the outflow pipe **172** is installed the filter **116**, and to the other end of the outflow pipe **172** is connected an air discharging passage **161** formed in the dust bin **150**. Accordingly, after whirling within a cyclone chamber **133**, air passes through the filter **116** and discharges through the air discharging passage **161** of the dust bin **150** via the outflow pipe **172**.

The air discharging passage **161** is formed to penetrate through the dust collecting chamber **153** of the dust bin **150** in upward and downward directions at a side of the dust collecting chamber **153**, and is connected with the outflow pipe **172**, so that the air discharged from the outflow pipe **172** of the cyclone unit **110** penetrates through the dust bin **150** and discharges in a direction toward a bottom end of the dust bin **150**. Here, the air discharging passage **161** may be formed, so that a width of air path thereof is gradually enlarged from an upper part to a lower part thereof. The air discharging passage **161** can be formed in a pipe shape, that is, substantially round in cross-section, but is not limited thereto. A top end of the air discharging passage **161** joined with the outflow pipe **172** has the same inner diameter as that of the outflow pipe **172**. The

outflow pipe **172** is configured, so that its lower part has an inner diameter gradually enlarged to become larger than that of its upper part, thereby allowing its bottom end to have the largest passage width. Accordingly, the more the air gets near to the bottom end of outflow pipe **172**, the more the flow speed of the air is reduced.

The inflow pipe **130** through which external air is flowed in penetrates through the outer body **122** of the cyclone body **120** and is connected to the inner body **124**.

The dust bin **150** has a very large volume as compared with that of the cyclone unit **110** and is vertically arranged, so that a Y-axis is a longitudinal axis thereof and thus the longitudinal axis thereof is perpendicular or substantially perpendicular to the longitudinal axis X of the cyclone unit **110**.

The dust bin **50** is divided into the dust collecting chamber **153** and the air discharging passage **161** by a partition **163**. A bottom surface **155** of the dust bin **150** is formed to bulge toward the dust collecting chamber **153** and the air discharging passage **161**.

The nonporous envelope **175**, which stores the dust or dirt collected into the dust bin **150**, is detachably disposed in the dust collecting chamber **153** of the dust bin **150**. That is, the nonporous envelope **175** is disposed, so that a top part thereof is interposed between the dust bin **150** and the cyclone body **120** when the dust bin **150** is coupled with the cyclone body **120** by a known cam lifting unit (not illustrated), which is installed under the dust-separating apparatus **100** to lift and lower the dust bin **150**. Preferably, but not necessarily, the nonporous envelope **175** is made of vinyl.

The pressure difference-generating passage **177** communicates the dust collecting chamber **153** with a filter chamber **196** of the filter unit **190** and the air discharging passage **161** connected with the outflow pipe **172** so as to allow the nonporous envelope **175** to come in contact with an inner surface of the dust collecting chamber **153** of the dust bin **150** by a pressure difference between the dust collecting chamber **153** and the filter chamber **196**/the air discharging passage **161**. For this, the pressure difference-generating passage **177** is provided with a plurality of openings **178**. The plurality of openings **178** is formed in the bottom surface **155** of the dust bin **155**, so that the dust collecting chamber **153** is directly communicated with the filter chamber **196**/the air discharging passage **161**. The plurality of openings **178** may be formed in the partition **163**, instead of or in addition to the bottom surface **155**.

Accordingly, when the air is drawn in by a suction motor (not illustrated) of the vacuum cleaner, a pressure difference is generated between the dust collecting chamber **153** and the filter chamber **196**/the air discharging passage **161** because the dust collecting chamber **153** is in fluid communication with the filter chamber **196** and the air discharging passage **161** through the plurality of openings **178**. At this time, the filter chamber **196** and the air discharging passage **161** have a pressure lower than that of the dust collecting chamber **153**. As a result, the nonporous envelope **175** is adhered closely to the inner surface of the dust collecting chamber **153**.

The filter unit **190** is joined to a bottom end of the dust bin **150**, and includes a filter cover **194** and a filter member **193**. The filter cover **194** is detachably locked and fixed to the bottom end of the dust bin **150** and forms the filter chamber **196** of predetermined volume therein. In addition, the filter cover **194** at a bottom surface thereof is formed an opening **160** through which the air past the filter member **193** is discharged. The opening **160** is connected directly or indirectly with the suction motor of the vacuum cleaner.

The filter chamber **193**, as a pleated cylindrical filter, the upper part of which is blocked and the lower part of which is opened, is vertically installed in the filter mount **195** of the filter chamber **196**.

As described above, the cyclone dust-separating apparatus **100** is configured so that the inner body **124** of the cyclone body **120** is formed to have the longitudinal axis X horizontally arranged and the dust bin **150** is formed to have the longitudinal axis Y vertically arranged. Accordingly, a size of the dust bin **150** can be increased as compared with other cyclone dust-separating apparatuses of the same height. Thus, the cyclone dust-separating apparatus according to the first exemplary embodiments of the present disclosure can increase the capacity of the dust bin **150**, thereby improving the convenience in use.

Further, since the air whirls on the horizontally arranged longitudinal axis X within the cyclone unit **110**, the dust or dirt stored in the nonporous envelope **175** of the dust collecting chamber **153** vertically arranged scarcely flows backward to the cyclone unit **110** again.

Furthermore, to empty the dust bin **150** of the dust or dirt collected therein, only the nonporous envelope **175** is separated from the dust bin **150** and dumped. Accordingly, a scattering of the dust or dirt and/or a contamination of circumference according to that is prevented.

Also, the air discharging passage **161** discharging the air from the cyclone chamber **133** is configured to pass through the dust bin **150**, thereby reducing the piping loss of the discharged air.

Now, an operation of the cyclone dust-separating apparatus **100** will be explained in detail with reference to FIGS. **1** and **2**.

First, if the suction motor of the vacuum cleaner is operated, external air is drawn into the cyclone chamber **133** through the inflow pipe **130**. The dawn-in air drops dust or dirt into the dust collecting chamber **153** of the dust bin **150** joined to the bottom end of the cyclone chamber **133** through a dirt discharge port **121** while whirling as indicated by arrows A in FIG. **2**.

With a suction force, the air from which the dust or dirt is removed as described above passes through the filter **116**, and bends its flow from a horizontal direction to a vertical-and-down direction while passing through the outflow pipe **172**. While the air passes through the air discharging passage **161** formed on the side of the dust bin **150**, the flow speed of the air is slowed down. When the air reaches the filter chamber **196**, the flow speed of the air goes down abruptly.

At this time, since the dust collecting chamber **153** of the dust bin **150** is communicated with the air discharging passage **161** through the plurality of openings **178**, a pressure difference is generated between the dust collecting chamber **153** and the filter chamber **196**/the air discharging passage **161**. As a result, the nonporous envelope **175** is adhered closely to the inner surface of the dust collecting chamber **153**.

The air flowed into the filter chamber **196** passes in a slow speed through the filter member **193** disposed in the filter chamber **196**, and thus fine dust remained in the air is collected by the filter member **193**. And then, the fine dust-removed air is discharged to the outside of the cyclone dust-separating apparatus **100** through the opening **160** formed in the filter cover **194**.

When the nonporous envelope **175** of the dust bin **150** is filled with the dust or dirt by the operation of the dust-separating apparatus **10** as described above, the dust bin **150** is separated from the cyclone body **120** of the cyclone unit **110** by the cam lifting unit. And then, to empty the dust bin **150** of

the dust or dirt collected therein, a user need only separate nonporous envelope **175** from the dust bin **150** and dump the dust or dirt. Thus, the dust bin **150** can be simply emptied.

FIGS. **3** through **7** are a side elevation, a perspective view and cross-sectional views exemplifying a cyclone dust-separating apparatus of a vacuum cleaner according to a second exemplary embodiment of the present disclosure.

As illustrated in FIGS. **3** through **7**, the cyclone dust-separating apparatus **200** includes a cyclone unit **210**, a dust bin **250**, a nonporous envelope **275**, and a pressure difference-generating passage **277**.

Referring to FIGS. **4** and **5**, the cyclone unit **210** includes a cyclone body **224**, a guide unit **211**, a filter **216**, an outflow pipe **218** and an inflow pipe **230**. In addition, the cyclone unit **210** horizontally extends, so that air is horizontally drawn thereinto and horizontally discharged therefrom. That is, the cyclone unit **210** is arranged in such a manner that its longitudinal axis X extends substantially in the horizontal direction, as illustrated in FIG. **5**.

The cyclone body **224** is made up of opposite side walls **224***a*, each of which is formed in a triangular shape with a rounded top apex, and a body part **224***b* interconnecting the side walls **224***a*. One side wall **224***a* is provided with a mounting opening **224***c*, in which the guide unit **211** is mounted, and the other side wall **224***a* is provided with the outflow pipe **218**, which extends into the inside of the cyclone body **224** and through which clean air can be discharged. Because the outflow pipe **218** extends parallel to the X-axis in the horizontal direction, an air outlet **226** (see FIG. **6**) through which the air is discharged is also formed in the horizontal direction. In addition, an inflow pipe **230**, through which external air is drawn in, is projected from the body part **224***b*. The cyclone body **224** has an extended part **234** extended around a lower end thereof to form an elongated groove **236** into which a top end of the dust bin **250** can be inserted. A sealing member (not shown) is inserted into the elongated groove **236** so as to seal a gap between the dust bin **250** and the cyclone body **224**. A dirt discharge port **220** is formed at a side of the cyclone body **224**, so that internal spaces of the cyclone body **224** and the dust bin **250** are communicated with each other and thus dirt or dust separated from the air drops into the dust bin **250**. The dirt discharge port **220** is formed in the circumferential direction of the body part **224***b* of the cyclone body **224** below a guide pipe **214**.

The guide unit **211** is mounted in the mounting opening **224***c* formed through one of the side walls **224***a* of the cyclone body **224**. The guide unit **211** has a knob **212** and a guide pipe **214**, wherein three locking holes **212***a* are formed in the knob **212** in the circumferential direction of the knob **212** and a handle **213** is projected from the center of the knob **212** so as to be capable of being gripped by a user. Locking projections **224***d* projecting from the side wall **224***a* of the cyclone body **224** are inserted into the locking holes **212***a*, respectively, so that the guide unit **211** is fixed to the cyclone body **224**. The guide pipe **214** is connected to a side of the knob **212** and extends into the inside of the cyclone body **224**. The guide unit **211** can be mounted in or removed from the cyclone body **224** merely by rotating the handle **213** of the knob **212**.

The filter **216** is removably mounted on an end of the outflow pipe **218**, and air drawn in into the inside of the cyclone body **224** is discharged to the outside via the filter **216** and the outflow pipe **218** after separating dirt or dust therefrom. In the present embodiment, the filter **216** is formed of a grill member with a plurality of through-holes. In the cyclone unit **210**, the guide pipe **214** and the outflow pipe **218** are substantially horizontally arranged.

As illustrated in FIGS. **4** and **6**, the inflow pipe **230**, as an air inflow part, is provided on the cyclone body **224** in the same direction as that of the outflow pipe **218** and is projected from a side of the body part of the cyclone body **224** in such a manner that an air inlet **228** through which air is drawn in is formed in the horizontal direction. As illustrated in FIG. **6**, the inflow pipe **230** is formed in an inverted L-shape.

Referring to FIGS. **3** and **7**, the dust bin **250** has a very large volume as compared with that of the cyclone unit **210** and is vertically arranged, so that axis Y is a longitudinal axis thereof and thus the longitudinal axis thereof is perpendicular or substantially perpendicular to the longitudinal axis of the cyclone unit **210**. The dust bin **250** has an outer tub **251**, and an inner tub **253** disposed in a spaced-apart relation to the outer tub **251** so as to form an air flowing space **256** between the outer tub **251** and the inner tub **253**. The inner tube **253** at an upper part thereof is joined with the outer tub **251**. In addition, the dust bin **250** is removably coupled to a bottom end of the cyclone unit **210** and has a handle **252** at a side thereof, so that a user grips the dust bin **250** thus to mount or remove it. Also, the dust bin **250** at a top end thereof is inserted into the elongated groove **236** formed on the bottom end of the cyclone body **224**.

The nonporous envelope **275**, which stores the dust or dirt collected into the dust bin **250**, is detachably disposed in the inner tub **253** of the dust bin **250**. That is, the nonporous envelope **275** is disposed, so that a top part thereof is interposed between the dust bin **250** and the cyclone body **224** when the dust bin **250** is assembled with the cyclone body **224**, like the nonporous envelope **175** of FIG. **2**. Preferably, but not necessarily, the nonporous envelope **275** is made of vinyl.

As illustrated in FIG. **7**, the pressure difference-generating passage **277** is in communication with the dust bin **250** with the outflow pipe **218** so as to allow the nonporous envelope **275** to come in contact with an inner surface of the inner tub **253** of the dust bin **250** by a pressure difference between the outflow pipe **218** and the dust bin **250**. For this, the pressure difference-generating passage **277** is provided with a subsidiary passage **276** and a plurality of openings **278**. The subsidiary passage **276** is disposed to connect between the outflow pipe **218** of the cyclone unit **210** and the outer tub **251** so as to communicate between the outflow pipe **218** and the air flowing space **256**. The subsidiary passage **276** is made up of a first connecting pipe **281** connected with the outflow pipe **218** and a second connecting pipe **282** connected to the outer tub **251**. The first and the second connecting pipes **281** and **282** are detachably coupled to each other. The plurality of openings **278** is formed in the inner tub **253** of the dust bin **250**, so that the inner tub **253** of the dust bin **250** is in direct communication with the subsidiary passage **276** through the air flowing space **256**.

Accordingly, when air is drawn in by a suction source (not illustrated), a pressure difference is generated between the inner tub **253** and the subsidiary passage **276** because the inner tub **253** is communicated with the subsidiary passage **276** through the plurality of openings **278**. As a result, the nonporous envelope **275** installed in the inner tub **253** of the dust bin **250** is adhered closely to the inner surface of the inner tub **253**.

Hereinafter, an operation of the cyclone dust-separating apparatus **200** will be described in detail with reference to FIGS. **6** and **7**.

Referring to FIGS. **6** and **7**, external air is drawn in through the air inlet **228** of the inflow pipe **230** projecting from the side of the cyclone body **224**, as indicated by arrow C in FIG. **6**.

The air flows along the inflow pipe **230** and a bent air flow passage **229** within the cyclone body **224** and moves toward the guide pipe **214** while whirling around the outflow pipe **218**, as indicated by arrows A in FIG. **6**. The guide pipe **214** serves to prevent the air from being dispersed from the center of rotation. Dust or dirt **254** suspended in the air drops to the dust bin **250** through the dirt discharge port **220** as indicated by arrow D.

FIG. **7** illustrates the dust or dirt **254** dropping to the dust bin **250**. Although dust or dirt **254**, which is heavier than the air, thereby being subjected to higher centrifugal force, drops to the dust bin **250**, the air is turned toward the filter **216** by a suction force transferred through the outflow pipe **218** and dust or dirt **254**, which has not yet removed from the air, is separated from the air while the air is passing through the filter **216**. And then, the air is discharged toward the vacuum motor of the vacuum cleaner through the outflow pipe **218** and the air outlet **226**.

At this time, because the whirling air stream formed in the cyclone chamber **222** is not transferred to the dust bin **250**, the dust or dirt **254** dropped into the dust bin **250** through the dirt discharge port **220** substantially does not flow backward to the cyclone unit **210**.

In addition, because the cyclone unit **210** is arranged horizontally as illustrated in FIG. **7**, it is possible to reduce the entire height of the cyclone dust-separating apparatus **200**. Accordingly, if the cyclone dust-separating apparatus is configured in the same height as the conventional cyclone dust-separating apparatus with the vertical cyclone unit, the volume of the dust bin **250** can be substantially increased as compared to that of the conventional one, whereby a period for emptying the dust bin **250** can be greatly increased.

If the user wants to dump the dust or dirt collected in the dust bin **250**, she or he grips the handle **252** provided on the dust bin **250** and removes the dust bin **250** from the cyclone unit **210**. And then, to empty the dust bin **250** of the dust or dirt collected therein, the nonporous envelope **275** is separated from the dust bin **250** and dumped.

In addition, if the user wants to clean the filter **216** of the cyclone unit **210** or the inside of the cyclone chamber **222**, she or he removes the filter **216** from the outflow pipe **218** so as to clean the filter **216** or cleans the cyclone chamber **222** through the mounting opening **224***c* formed on the cyclone body **224**, after removing the guide unit **211** from the cyclone body **24**.

FIGS. **8** through **10**B are a side elevation, an exploded perspective view, and cross-sectional views exemplifying a cyclone dust-separating apparatus **300**.

Referring to FIGS. **8** through **10**B, the cyclone dust-separating apparatus **300** includes a cyclone unit **110**, a dust bin **350**, a nonporous envelope **175**, a pressure difference-generating passage **377**, and a filter unit **390**. Because constructions of the cyclone unit **10** and the nonporous envelope **175** are the same as those of the cyclone dust-separating apparatus **100** as described above with reference to FIGS. **1** and **2**, a detailed description thereof will be omitted for clarity and conciseness.

Unlike the dust bin **150** of the cyclone dust-separating apparatus **100**, the dust bin **350** is formed in a cylindrical shape outside an outer circumferential surface of an air discharging passage **361**.

As illustrated in FIGS. **9** and **11**A, the air discharging passage **361** is disposed between the outflow pipe **172** and the filter unit **390**, so that air discharged from the outflow pipe **172** of the cyclone unit **110** is flowed into a filter chamber **396** of the filter unit **390** on a bottom part of the dust bin **350** while moving along an outside of the dust bin **350** and discharged from the filter chamber **396**. The air discharging passage **361** is made up of first, second and third ducts **362**, **363** and **364** respectively. The first duct **362** is installed to surround the outer tub **122** on a side of an outer circumferential surface of the outer tub **122** of the cyclone body **120**, and guides the air discharged from the outflow pipe **172** to the second duct **363**. The second duct **363** at an upper part thereof is connected to the first duct **362** and extended to a lower part of the dust bin **350** along a side of an outer circumferential surface of the dust bin **350**. The second duct **363** guides the air discharged from the first duct **362** to the third duct **364** formed to the filter unit **390**. The third duct **364** is formed on a side of an outer circumferential surface of the filter unit **390**, and guides the air discharged from the third duct **364** into the filter chamber **396** of the filter unit **390**.

As illustrated in FIG. **11**A, the pressure difference-generating passage **377** is made up of a plurality of openings **378** formed in a cross-shaped arrangement on a bottom surface **355** of the dust bin **350**, so that the dust collecting chamber **353** of the dust bin **350** is directly communicated with the air discharging passage **361** and the filter chamber **396**.

To close up the plurality of opens **378** when the nonporous envelope **175** is not used, a close up-switching part **380** is installed on the bottom surface **355** of the dust bin **350** in which the plurality of openings **378** of the pressure difference-generating passage **377** is formed. As illustrated in FIGS. **9** through **11**A, the close up-switching part **380** is made up of a rotating plate **381** and a switching knob **385**. The rotating plate **381** is rotatably disposed on the bottom surface **355** of the dust bin **350**, and has a plurality of homologous openings **386** formed in a cross-shaped arrangement to correspond to the plurality of openings **378**. To rotatably support the rotating plate **381** on the bottom surface **355** of the dust bin **350**, a center supporting axis (not illustrated) of the rotating plate **381** is connected to a supporting part **379** while penetrating through the bottom surface **355**. Also, preferably, but not necessarily, the rotating plate **381** is formed in almost the same size as the bottom surface **355**. The switching knob **385**, which rotates the rotating plate **381**, is formed in the center of an upper surface of the rotating plate **381**.

Accordingly, if the nonporous envelope **175** is used, as illustrated in FIGS. **10**A and **11**A, a user rotates the rotating plate **381** by using the switching knob **385**, so that the homologous openings **386** are aligned with the openings **378**. As a result, the dust collecting chamber **353** of the dust bin **350** is brought into fluid communication with the air discharging passage **361** and the filter chamber **396** through the openings **378**. Thus, when air is drawn into the cyclone dust-separating apparatus **300** by a suction motor (not illustrated) of the vacuum cleaner, a pressure difference is generated between the dust collecting chamber **353** and the filter chamber **396**/the air discharging passage **361**. At this time, the filter chamber **196** and the air discharging passage **361** have a pressure lower than that of the dust collecting chamber **353**. As a result, the nonporous envelope **175** is adhered closely to an inner surface of the dust collecting chamber **353** and an upper surface of the rotating plate **381**.

To the contrary, if the nonporous envelope **175** is not used, as illustrated in FIGS. **10**B and **11**B, the user rotates the rotating plate **381** by an angle of approximately 45° from a position illustrated in FIGS. **10**A and **11**A by using the switching knob **385**, so that the homologous openings **386** is not aligned with the openings **378**. Accordingly, the dust collecting chamber **353** of the dust bin **350** is not communicated with the air discharging passage **361** and the filter chamber **396**, but isolated therefrom, as in the general cyclone dust-separating apparatus.

To filter dust or dirt included in the air discharged from the cyclone unit **110**, the filter unit **390** is joined to a bottom end of the dust bin **350**.

The filter unit **390** includes a filter cover **394** and a filter member **392**. The filter cover **394** is detachably coupled to the bottom end of the dust bin **350** and forms a filter chamber **396** of predetermined volume therein. The filter cover **394** at a side thereof has a third duct **363** of the air discharging passage **361**, which is connected to a lower part of the second duct **363** to draw in air from a second duct **363**. In addition, the filter cover **394** at a bottom surface thereof is formed an opening **360** through which the air past the filter member **392** is discharged. The opening **360** is connected directly or indirectly with the suction motor of the vacuum cleaner. The filter member **392** may be formed of a porous filter, such as a sponge or the like, fixed in a filter mount **394** of the filter cover **394**.

An operation of the cyclone dust-separating apparatus **300** constructed as described above is the same as that of the cyclone dust-separating apparatus **100** explained with reference to FIGS. **1** and **2**, except that the air discharged from the outflow pipe **172** of the cyclone unit **110** is drawn into the filter chamber **396** through the air discharging passage **361** installed on the side of the outer circumferential surface of the dust bin **350** and when the nonporous envelope **175** is not used, the cyclone dust-separating apparatus **300** is operated as in the general cyclone dust-separating apparatus to which the nonporous envelope **175** is not applied by closing up the openings **378** of the pressure difference-generating passage **377**, as illustrated in FIGS. **10**B and **11**B. Accordingly, a detailed description on the operation of the cyclone dust-separating apparatus **300** will be omitted for clarity and conciseness.

As apparent from the foregoing description, according to the exemplary embodiments of the present disclosure, the cyclone dust-separating apparatus is configured, so that the cyclone unit is installed to have the longitudinal axis horizontally arranged and the height of the dust bin is increased. Accordingly, the cyclone dust-separating apparatus according to the exemplary embodiments of the present disclosure can increase the capacity of the dust bin, thereby improving the convenience in use.

Further, the cyclone dust-separating apparatus according to the exemplary embodiments of the present disclosure has the horizontal cyclone unit and the vertical dust bin. Accordingly, because the air stream whirling in the cyclone unit is not spread to the inside of the dust bin, the dust or dirt stored in the dust bin is prevented from flowing backward to the cyclone unit again.

Furthermore, the cyclone dust-separating apparatus according to the exemplary embodiments of the present disclosure is configured so that for a user to empty the dust bin of the dust or dirt collected therein, only the nonporous envelope is separated from the dust bin and dumped. Accordingly, the scattering of the dust or dirt and/or the contamination of circumference according thereto are prevented.

Further, the cyclone dust-separating apparatus according to the exemplary embodiments of the present disclosure is configured, so that the guide unit is removably mounted on the cyclone body. Accordingly, the cyclone dust-separating apparatus according to the exemplary embodiments of the present disclosure has a cyclone unit with a conveniently-cleanable filter and inside.

Moreover, the cyclone dust-separating apparatus according to the exemplary embodiments of the present disclosure is configured so that the guide pipe extends into the cyclone unit from the guide unit by a predetermined length. Accordingly, the cyclone dust-separating apparatus according to the exemplary embodiments of the present disclosure allows the whirling air stream formed in the cyclone chamber to retain the rotating force without being dispersed.

In addition, the cyclone dust-separating apparatus according to the exemplary embodiments of the present disclosure is configured so that the air discharging passage discharging the air from the cyclone unit passes through the dust bin, thereby reducing the piping loss of the discharged air.

Also, the cyclone dust-separating apparatus according to the exemplary embodiments of the present disclosure is configured, so that the cyclone unit first separates the dust or dirt from the air and the filter unit filters the fine dust laden in the air once again, thereby improving the dust-separating efficiency.

Although representative embodiments of the present disclosure have been shown and described in order to exemplify the principle of the present disclosure, the present disclosure is not limited to the specific embodiments. It will be understood that various modifications and changes can be made by one skilled in the art without departing from the spirit and scope of the invention as defined by the appended claims. Therefore, it shall be considered that such modifications, changes and equivalents thereof are all included within the scope of the present disclosure.

What is claimed is:

1. A cyclone dust-separating apparatus comprising:

a cyclone unit having an air inflow part and an air outflow part so as to separate dust or dirt from air, the cyclone unit being installed in such a manner that a longitudinal axis thereof is substantially horizontally arranged;

a dust bin joined to a bottom end of the cyclone unit so as to collect the dust or dirt separated by the cyclone unit, the dust bin being installed in such a manner that a longitudinal axis thereof is substantially perpendicular to the longitudinal axis of the cyclone unit;

a nonporous envelope detachably disposed in the dust bin so as to store the dust or dirt collected into the dust bin; and

a pressure difference-generating passage to communicate an outlet of the air outflow part and the dust bin with each other so as to allow the nonporous envelope to come in contact with an inner surface of the dust bin by a pressure difference between the dust bin and the air outflow part.

2. The apparatus as claimed in claim **1**, wherein the dust bin comprises an air discharging passage connected with the air outflow part, so that the air discharged from the cyclone unit penetrates through the dust bin and discharges in a direction toward a bottom end of the dust bin.

3. The apparatus as claimed in claim **2**, wherein the pressure difference-generating passage comprises a plurality of openings formed in the dust bin so as to allow the dust bin to communicate with the air discharging passage.

4. The apparatus as claimed in claim **3**, wherein the air discharging passage is disposed to penetrate through a dust bin chamber of the dust bin in upward and downward directions.

5. The apparatus as claimed in claim **4**, wherein the air discharging passage is formed on one side of the dust bin chamber, and wherein the air discharging passage has a width that gradually increases between an upper and a lower part of the air discharging passage.

6. The apparatus as claimed in claim **5**, further comprising a filter unit joined to the bottom end of the dust bin so as to filter dust or dirt included in the air discharged through the air discharging passage from the cyclone unit.

7. The apparatus as claimed in claim 6, wherein the filter unit comprises:

a filter cover joined to the bottom end of the dust bin to form a filter chamber having a predetermined volume; and

a filter member disposed in the filter chamber.

8. The apparatus as claimed in claim 7, wherein the filter member comprises a pleated cylindrical filter, an upper part of which is substantially impedes airflow therethrough.

9. The apparatus as claimed in claim 1, wherein the dust bin comprises:

an outer tub; and

an inner tub disposed in a spaced-apart relation to the outer tub so as to form an air flowing space between the outer tub and the inner tub, the inner tube at an upper part thereof being joined with the outer tub.

10. The apparatus as claimed in claim 9, wherein the pressure difference-generating passage comprises:

a subsidiary passage disposed between the air outflow part of the cyclone unit and the outer tub so as to place the air outflow part and the air flowing space in fluid communication; and

a plurality of openings formed in the inner tub of the dust bin so as to place the inner tub of the dust bin, the subsidiary passage, and the air flowing space in fluid communication.

11. The apparatus as claimed in claim 1, further comprising an air discharging passage connected with the air outflow part, so that the air discharged from the cyclone unit is flowed in a direction toward a bottom end of the dust bin along an outside of the dust bin and then discharged.

12. The apparatus as claimed in claim 11, wherein the pressure difference-generating passage comprises a plurality of openings formed in the dust bin so as to place the dust bin and the air discharging passage in fluid communication.

13. The apparatus as claimed in claim 12, wherein a close up-switching part is disposed to the pressure difference-generating passage so as to close up the plurality of openings when the nonporous envelope is not used.

14. The apparatus as claimed in claim 13, wherein the close up-switching part comprises:

a plate rotatably disposed to the dust bin and having a plurality of homologous openings corresponding to the plurality of openings; and

a handle formed on the rotating plate.

15. The apparatus as claimed in claim 14, further comprising a filter unit joined to the bottom end of the dust bin so as to filter dust or dirt included in the air discharged through the air discharging passage from the cyclone unit.

16. The apparatus as claimed in claim 15, wherein the filter unit comprises:

a filter cover joined to the bottom end of the dust bin to form a filter chamber in a predetermined volume; and

a filter member disposed in the filter chamber.

17. The apparatus as claimed in claim 16, wherein the filter member comprises a porous filter fixed on a filter mount of the filter cover.

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